

## REVIEW ARTICLE



# Vaginoplasty in Male to Female transgenders: single center experience and a narrative review

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Vaginoplasty in Male to Female (M to F) transgenders is a challenging procedure, often accompanied by numerous complications. Nowadays the most commonly used technique involves inverted penile and scrotal flaps. In this paper the data of 47 M to F patients who have undergone sex affirmation surgery at the Department of Urology of the University of Trieste, Italy since 2014, using our modified vaginoplasty technique with the “Y” shaped urethral flap, have been retrospectively reviewed. Moreover, a non structured review of the literature with regards to short and long-term complications of vaginoplasty has been provided. All patients followed a standardized neo-vaginal dilation protocol. At follow up 2 patients were lost. At 12 months 88.9% of patients (40/45) were able to reach climax, 75.6% (34/45) were having neo-vaginal intercourses and median neo-vaginal depth was 11 cm (IQR 9–13.25): no statistically significant decrease in depth was found at follow up. Only one patient was dissatisfied with aesthetic appearance at 12 months. Our technique provided excellent cosmetic and functional results without severe complications (Clavien–Dindo  $\geq$  3). The review of the literature has highlighted the need to standardize a postoperative follow up protocol with particular regard to postoperative dilatation regimen. Further, larger randomized clinical trials are pending to draw definitive conclusions.

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## INTRODUCTION

Patients diagnosed with Male to Female (M to F) Gender Dysphoria (GD) require a complex multidisciplinary management [1]. Vaginoplasty represents the cornerstone of sex affirmation surgery in M to F patients and an increasing number of patients have decided to undergo this surgical procedure over the years [2].

The goal of vaginoplasty is not only to create external genitalia that closely resemble those of a genetic female, but also to guarantee the tactile and erogenous sensation necessary to achieve a climax [3, 4].

Although no vaginoplasty technique has proved to be the gold standard, the most commonly used technique involves the utilization of inverted penile and scrotal flaps for neo-vagina e neo-vulva formation [5, 6].

Despite recent years have been characterised by major breakthroughs in surgical techniques, intra and postoperative complications that lead to poor cosmetic and functional results after vaginoplasty are not uncommon [7].

In this paper the data of 47 M to F transgender women who have undergone sex affirmation surgery using our modified vaginoplasty technique at the Department of Urology of the University of Trieste, Italy since 2014 have been retrospectively reviewed. Moreover, a non structured review of the literature with regards to short and long-term complications of vaginoplasty has been provided.

## MATERIALS/SUBJECTS AND METHODS

### Study setting and patients

The present study was carried out according to the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The present study was approved by the local Ethical Committee (Comitato Etico Unico Regionale - CEUR - ARCS, IRB number: Parere CEUR-2021-Os-153). Written informed consent was obtained for all patients included in the current series. All clinical notes containing sensitive information about patients were redacted in order to ensure analysis of anonymous data only.

From June 2014 to June 2019, 47 M to F patients underwent vaginoplasty at the Department of Urology of the University of Trieste. Our technique is based on a modification of the original intervention described by Jones [8] and involves the following steps:

1. Inverted “drop shaped” scrotal incision and bilateral orchiectomy
2. Subtotal penectomy (preservation of skin and underlying Dartos layer, neurovascular bundle and glans penis, bulbar urethra)
3. Urethrostomy
4. Vaginoplasty
5. Creation of labia
6. Modelling of the neo-clitoris

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### Preoperative work-up

All patients underwent permanent laser epilation of perineal area and genitalia prior to surgery. Hormonal therapy was discontinued one month before surgery in order to minimize thromboembolic risk. To reduce operative times, surgery is usually carried out by 2 separate surgical teams while the patient is placed in a lithotomy position. As a common rule, one team is positioned on the sides of the patient to perform the degloving and disassembly of the penis while the other is located between the patient's legs to carry out the remaining steps of the procedure.

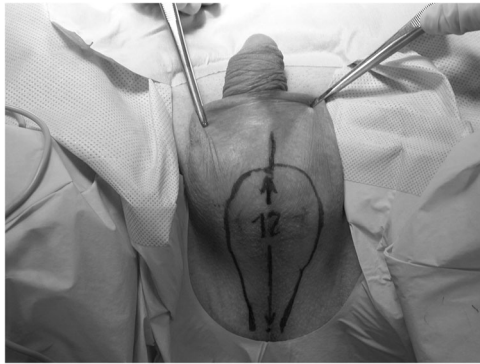
### Surgical procedure

The surgical procedure involves the following steps:

**Step 1: Scrotal incision and bilateral orchiectomy.** Based on patient's anatomy, a 12–15 cm long “inverted drop” shaped incision is carried out on the perineum and on the scrotum (Fig. 1). The 2 ends of the incision are extended dorsally until 1 cm from the anal orifice. Cranially, the apex of the incision sits at the peno-scrotal junction, thus separating the scrotal flap from the penile flap that will be later used to create the anterior neo-vaginal wall.

The scrotal flap will form the posterior neo-vaginal wall and at the same time will provide direct access to testes, spermatic cords and bulbar urethra. At this stage the bilateral orchiectomy is performed; the spermatic cord is usually divided and tied at the level of the external inguinal ring, as high as feasibly possible.

**Step 2: Penectomy (preservation of skin, glans, neurovascular bundle, urethra).** Once the bilateral orchiectomy has been completed, the penis is disassembled in its anatomical components. The corpora cavernosa are removed en-block with the crura. Penile skin and Dartos are carefully preserved to obtain an adequately



**Fig. 1** The “inverted drop” shaped incision of perineum and scrotum.

vascularised flap. Certainly, penile size and a circumcision status affect significantly the dimensions of this flap.

The neurovascular bundle and glans penis are carefully dissected off the tunica albuginea of the corpora cavernosa (Fig. 2a, b). The dissection is extended proximally up to the pubis and the corpora cavernosa are completely dissected off to allow for a subtotal penectomy. The bulbar urethra is incised longitudinally in a “Y” shape (Fig. 3), thus obtaining a ~10 cm long “Y” shaped urethral flap [9]. The neurovascular bundle is gently folded on itself to help recreating the Mons Venus, thus improving the aesthetic result. It is paramount to avoid any form of kinking of the neurovascular bundle, as this can potentially cause compression of the dorsal vein and arteries and lead to ischemia of the neo-clitoris. A 16 Ch Foley urethral catheter is then inserted in the urinary bladder.

**Step 3: Urethrostomy.** A stay suture is positioned in the midline at the 6 o'clock position on the lower arm of the urethral flap in order to ensure that the urethrostomy is fashioned along the midline. This stitch will also represent the landmark point for neo-clitoris positioning.

**Step 4: Vaginoplasty.** The anterior perineum is incised in the midline and the fibres of the bulbocavernosus muscle are spread reaching the bulbar urethra and the central tendon of the perineum.

In order to expose the urogenital diaphragm, Colles' fascia is dissected off laterally and the superficial and deep transverse perineal muscles are spread apart.

The central tendon of the perineum and the musculofascial structures between rectum and urethra are dissected. The blunt dissection is carried out with scissors and fingers and is extended cranially up to the Douglas pouch.

This dissection creates a virtual space in the ischio-rectal fossa, which will eventually accommodate the neo-vagina. The limits of this cavity are the prostate, the Denonvilliers' fascia and the membranous urethra anteriorly, and the rectum posteriorly.

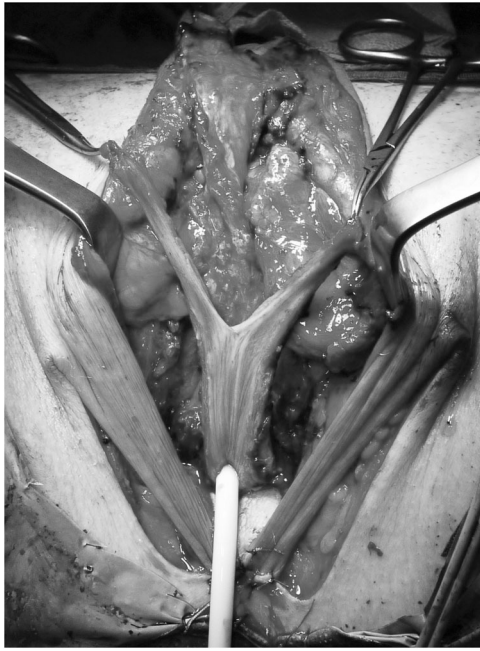
The edges of the scrotal and penile flaps are sutured together using 3 or 4-0 absorbable sutures to form a cylindrical pouch (Fig. 4) that is subsequently inverted and pushed in the newly dissected cavity.

The dome of the pouch is anchored to the cranial part of the Denonvilliers fascia and the lateral walls to the sacrospinous ligaments. In order to minimise the risk of prolapse of the neo-vagina itself, the dome of the pouch is secured with stitches to the vault of the newly dissected cavity.

**Step 5: Creation of labia.** The labia minora are obtained by suturing together the edges of the urethral and penile skin flap while the labia majora are created by suturing the margins of



**Fig. 2** **a** Isolation of the dorsal neurovascular bundle, **b** The neurovascular bundle dissected off en-block with the glans penis.



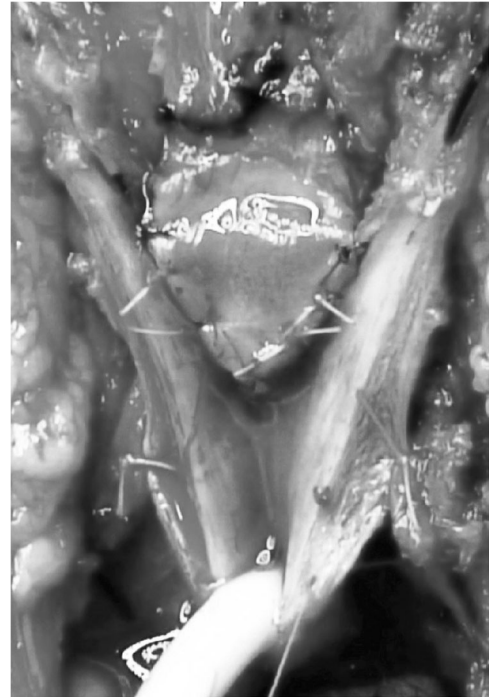
**Fig. 3** Creation of the "Y" shaped urethral flap.



**Fig. 4** The scrotal and penile flaps are sutured together.

penile and scrotal flaps. The apex of labia majora are then pulled over with some stitches at the 6 o'clock position, conferring a more natural appearance. The "drop" shaped surgical incision is closed in a running suture.

**Step 6: Modelling of the neo-clitoris.** The dorsal part of the glans penis is trimmed down to resemble a neo-clitoral glans. Our team has refined this technique by embedding the neo-clitoris in the urethral mucosa by suturing it in a double layer at the junction between the two upper arms of the "Y" shaped urethral flap (Fig. 5). The aim of this modification is to improve sensitivity and trophism of the neo-clitoris by embedding it in a moist mucosal environment. The two layered sutures allow to establish a vascular



**Fig. 5** The neo-clitoris embedded in the "Y" shaped urethral flap.

support between neo-clitoris and spongiosum of the urethra thus reducing the risk of ischemia. In order to achieve a more natural cosmetic result, the neo-clitoris is anchored to the remnants of the suspensory ligament of the penis and externalized through a longitudinal midline incision in the penoscrotal flap.

An inflatable adjustable stent (Fig. 6) is positioned in the neo-vaginal cavity to maintain it patent.

Finally, a compressive dressing is applied to the external genitalia and kept in place for 36–48 h to reduce the risk of haematoma and oedema formation.

#### Postoperative management

All patients were instructed to lay in bed in a supine position for the first 36–48 h postoperatively and were prescribed thromboembolic prophylaxis with low molecular weight heparin. The compressive dressing and the neo-vaginal stent were usually removed on postoperative day 3 in order to assess the vitality of the skin flaps and the integrity of urethra and rectum. The urethral catheter was usually removed the day after, and patients were trained by a surgeon and a specialist nurse on how to perform self-dilations of the neo-vaginal cavity. Patients were instructed to perform the self-dilatations for 5–10 minutes at least 4–5 times a day. Patients were instructed to switch gradually to dilators with increasing diameter in order to guarantee an adequate stretch of the neo-vagina.

Patients were also instructed to maintain an adjustable vaginal stent in situ while sleeping to ensure continuous dilation of the neo-vagina.

We generally use the Amielle Comfort® Owen Mumford Ltd - UK dilators set with increasing sizes ranging from 9 × 2 cm to 14 × 3 or 16 × 3.5 cm. According to our experience, neo-vaginal dilations must be started as soon as possible to minimize the risk of contracture or stenosis. Once discharged in the community, patients are advised to perform 3–5 dilations daily for the first 6 months, then at least two dilations daily for the rest of their life even if they are having regular neo-vaginal intercourses. Patients were closely followed by a psychosexual therapist throughout their hospital stay. Hormonal therapy was adjusted by an endocrinologist after the bilateral orchiectomy and resumed ten





**Fig. 6** Final result and neo-vaginal stent placement.

days after surgery, once the patient was fully mobile, in order to minimize thromboembolic risk. As the most part of the patients had been referred to our Department from other Italian regions, they were discharged only once they were completely autonomous in the self-dilatations and the surgical wounds had healed adequately.

#### Follow up

Follow-up was scheduled at 3 and 12 months postoperatively. Assessment involved neo-vaginal direct examination with a speculum and measurement of the depth of the cavity. Patients were directly questioned to establish whether they were able to achieve an orgasm, whether they were engaging in penetrative sexual activity and if they had experienced dyspareunia. Patients' satisfaction rates in terms of the cosmetic appearance of the external genitalia were also recorded.

#### Outcomes' measurement

The medical records of the patients enrolled were retrospectively reviewed and intra and postoperative complications were identified and categorised according to the Clavien–Dindo classification [10, 11].

A bibliographic search using Medline and EMBASE for relevant publications using as key words “vaginoplasty”, “transgender”, “complications”, “outcomes” and “management” was performed.

Only original articles published in English language were included. Suitable publications were reviewed by all Authors to decide whether they were suitable for inclusion.

#### Statistical analysis

Differences in neo-vaginal depth at the time of surgery, at 3 and 12 months were compared using *t*-test (coupled, 2-tails).

#### RESULTS

Between June 2014 and June 2019, 47 M to F patients underwent vaginoplasty as part of sex affirmation surgery.

Median age at the time of surgery was 35 years (IQR 27–46) and median hospital stay was 13 days (IQR 10–14).

Intra and postoperative complications are reported in Table 1.

**Table 1.** Intra and postoperative complications.

Intraoperative complications	
Overall	2/47 (4.3%)
Rectal injury	1/47 (2.1%)
Urethral injury	1/47 (2.1%)
Postoperative complications	
Overall	19/47 (40.4%)
Clavien–Dindo I	
Urinary retention after catheter removal	2/19 (10.5%)
Hematoma of the labia majora	4/19 (21.1%)
Urethral flap partial necrosis	1/19 (5.3%)
Total	7/19 (36.8%)
Clavien–Dindo II	
Fever with raised inflammatory markers	12/19 (63.2%)

With regards to intraoperative complications, a minor rectal injury occurred in one case and an urethral injury in another one. Both injuries were primarily repaired intraoperatively, and no further surgical interventions were subsequently required.

Overall, postoperative complications occurred in 19 patients (40.4%). The complications were classified as Clavien–Dindo I in 7 patients (36.8%). In particular, 2 patients failed their trial without catheter, 4 developed a hematoma of the labia majora and one experienced a partial necrosis in the distal part of the urethral flap. The 4 patients experiencing hematomas and the one developing the partial necrosis of the urethral flap were managed conservatively by the local tissue viability nurse and did not need further surgical interventions.

Overall, 12 patients (63.2%) had a complication classified as Clavien–Dindo II as they developed fever with raised inflammatory markers in the postoperative period, which was empirically managed with broad spectrum antibiotics.

No complications classified as Clavien–Dindo  $\geq 3$  were recorded.

Median neo-vaginal depth at the time of surgery was 11.5 cm (IQR 11–12.5).

Overall, 45 patients of the 47 patients initially enrolled in the series were followed up at 3 and 12 months, as 2 were lost to follow up.

Median neo-vaginal depth measured at 3 months was 12 cm (IQR 10.5–12.5); 16 patients (35.6%) were able to reach climax and 11 (24.4%) had successfully completed a neo-vaginal penetrative intercourse. One patient (2.2%) reported dyspareunia.

Two patients were dissatisfied with the aesthetic result, as they felt that the labia majora were larger than expected and asymmetrical, but did not complain about neo-vaginal depth (12 and 11.5 cm, respectively) and erogenous sensitivity.

At the 12 months follow up visit, median neo-vaginal depth was 11 cm (IQR 9–13.25) with 40 patients (88.9%) able to reach orgasm and 34 (75.6%) having neo-vaginal intercourses. Two (4.4%) patients complained of dyspareunia and one remained dissatisfied with the aesthetic result at 12 months. Of note this patient's neo-vaginal depth was 12 cm at one year follow up. She had engaged in neo-vaginal intercourses and was able to reach a climax but still felt that her labia majora were larger than expected and asymmetrical.

Neo-vaginal depth at surgery was compared to neo-vaginal depth at 3 and 12 months: no statistically significant differences were found ( $p = 0.63$  and  $0.25$ , respectively).

No statistically significant differences in depth between 3 and 12 months ( $p = 0.19$ ) were recorded.

Due to the size of their penis, a shorter neo-vaginal depth was achieved at the time of surgery in 2 patients (respectively 8 and 7.5 cm). Since both patients refused to follow the dilation protocol

after surgery neovaginal depth was 3 and 4.5 cm at 3 months and 3 cm for both patients at 12 months.

No patients regretted the decision to undergo vaginoplasty.

## DISCUSSION

Vaginoplasty for M to F transgender patients is a complex procedure. Complications have been previously described [12, 13] and can be distinguished in intra- and post-operative. The latter can be further subdivided in short and long term.

### Intraoperative complications

*Rectal injury occurring during neo-vaginal cavity creation.* Previous studies indicate that the incidence of rectal injury ranges between 2 and 4.2% [14–16] and this complication can lead to the formation of a recto neo-vaginal fistula postoperatively.

Dissection of the neo-vaginal space is perhaps the most challenging step of the vaginoplasty, as it consists of a blind manoeuvre and involves forming a cavity just a few millimetres away from the rectal wall. Therefore, it is not surprising that rectal injuries are not uncommon.

In order to minimize the risk of inadvertent rectal injury, the dissection needs to be carried out respecting the anatomical planes and the surgeon needs to rely on bimanual examination placing a finger of his non dominant hand in the rectum while he is carrying out the blunt dissection with his dominant hand [17].

According to previous series, the majority of rectal tears, if promptly identified, can be repaired intraoperatively without subsequent leakage [18].

This is in line with our experience, where a minor rectal injury was immediately recognized and adequately repaired intraoperatively without postoperative sequelae.

*Injury of the neurovascular bundle.* Injury to the neurovascular bundle of the neo-clitoris has also been described in literature; this complication was observed in 1–3% of cases [19, 20].

It may affect the neural structures, resulting in decreased sensitivity, or the deep dorsal arteries or veins, resulting in neo-clitoris necrosis. The risk of damage to the neurovascular bundle can be minimised with the use of magnifying loops and by carrying out the procedure using blunt dissection and while an artificial erection is induced.

### Short term postoperative complications

*Bleeding from the urethral edge.* The main source of post-operative bleeding is from the urethral spongy tissue. This complication can occur approximately in 4.5% of cases [21]. In our experience, the placement of full thickness spongiosal running sutures along the edges of the urethra, mucosal eversion and adequate compression may reduce postoperative bleeding of the dissected spongy tissue.

*Hematoma and flaps necrosis.* Many series reported impaired wound healing as the most common complication, although in the majority of cases healing eventually occurs by second intention without the need for surgical intervention [22]. In the current series, 5 patients reported minor vascular complications (four cases of hematoma of labia majora and one partial necrosis of the urethral flap) and were managed successfully conservatively by the tissue viability nurse.

### Long-term postoperative complications

*Neo-vaginal stenosis.* Previous Authors reported neo-vaginal introitus strictures ranging from 4.2 to 15% [15, 23], with up to 10% of patients reporting neo-vaginal shrinkage [6]. Overall, strictures can occur in 7% of cases (1–12%) [16].

Stricture and shrinkage are serious complications and surgical correction is required in up to 41% of cases [24].

Although available guidelines highlight the importance of counselling patients regarding the need of regular dilations or penetrative intercourses to maintain neo-vaginal depth and width [1], no clear indications about dilation regimens and follow up protocols are given.

Moreover, in the published literature there is no consensus regarding the exact frequency and duration of neo-vaginal dilations and there is no clear indication whether the dilations need to be continued life-long or not.

In a series published in 2015, Raigosa instructed patients to perform self-dilations 3 times per day in the first month and 2 times per day in the second month. The recommended frequency after 1 year was 2 times per week. In that series an acceptable vaginal depth and erogenous sensitivity were achieved in all patients and 86% of them was engaging in regular sexual intercourses [25].

In a series of 24 patients, Amend et al. recommended the use of an air-filled dilator that was continuously kept in the neo-vagina and removed twice a day for the first 2 months postoperatively. Six to 8 weeks after surgery patients were allowed to have neo-vaginal sexual intercourses and to use a solid phantom instead of the air filled dilator. No more detailed indications on dilation frequency were provided by the Authors. According to Authors, all the 24 patients of their series were satisfied with a mean neo-vaginal depth of 11 cm (range 10–14) [15].

On the other hand, Cristofari et al. did not prescribe any routine dilation protocol in sexually active patients without finding any significative increase in stenosis and secondary revision rates. In Cristofari's series, patients were instructed to perform dilations with a self-made soft stent until a complete neo-vaginal healing had occurred. A dilation protocol with hard dilators was prescribed only in case of stenosis or of medium-short neo-vaginas with a depth between 8 and 12 cm [26].

In the current study, patients were instructed to perform 3–5 self-dilations every day in the first 6 months after surgery and at least 2 times daily afterwards.

Based on our experience, we believe that regular neo-vaginal dilations should be recommended to all patients, even if they are sexually active. An accurate counselling must be performed as discontinuation or non-compliance to postoperative dilations are known risk factors for stenosis and loss of depth [23, 27].

Although we found no statistically significant differences in median neo-vaginal depth at 3 and 12 months, we noticed a minimal and reasonably predictable decreasing trend over months despite regular dilations with a significant shortening occurring only in those patients who refused to comply with the self-dilation regimen.

With no doubt our results suggest that performing regular self-dilations could be beneficial in improving long-term outcomes and may reduce the need of revision surgery.

In addition, the published literature does not report data on medical-legal issues regarding litigation after surgery. Considering that litigations are on the rise, recommending a standardized dilation regimen could help to reduce medical-legal claims.

Management of neo-vaginal stenosis can be quite complex and surgical revision can be challenging even in the hands of the most experienced surgeons.

The mainstay of conservative treatment is the use of rigid dilators to gently stretch and expand the strictured neo-vagina [26, 28]. When conservative treatment yields inadequate results, an augmenting vaginoplasty using intestinal segments represents the first choice treatment for neo-vaginal reconstruction. In these cases, a pedicled segment of sigmoid colon or ileum is used to reconstruct a neo-vagina with an acceptable depth and girth. Both sigmoid and ileal vaginoplasty can provide good results in terms of sexual quality of life without exposing patients to severe morbidity [29]. A total or combined laparoscopic technique can be used to minimize invasiveness while performing an augmenting vaginoplasty [30].

### Recto-neovaginal fistula

With an incidence ranging between 1 and 4.2% [15, 31], recto-neovaginal fistulas may occur as a result of an intraoperative rectal injury or be secondary to ischemia as, during neo-vaginal cavity creation, the connective tissue containing the vascular supply of the junction between inferior mesenteric and hemorrhoidal vessels is stripped off from anterior rectal wall. More unlikely ischemia or injury can be caused by dilator misuse. A temporary colostomy is required when a fistula occurs: in 50% of cases temporary colostomy is resolute and no further surgical interventions are needed [18]. An early identification of fistulas is mandatory and Magnetic Resonance Imaging (MRI) can be very useful in the early diagnosis of this complication, when clinical features are inconclusive [32].

### Neo-vaginal prolapse

Overall, the prevalence of neo-vaginal prolapse reported in the literature ranges between 1 and 2% [3, 20]. As reported by Bucci et al. in 2014, prolapses, either partial or total, typically occur within 6 months from surgery. Risks of prolapse can be minimized by an adequate fixation with sutures of the neo-vaginal vault to both Denonvilliers fascia and prerectal fascia [33]. In the present series, where all the neo-vaginal dome had been sutured to the Denonvilliers fascia in all patients, no cases of prolapse were reported. Not all Authors agree that adequate fixation of the neo-vaginal dome is necessary to avoid prolapse. In particular, in a series of 40 patients, Papadopoulos et al. did not report cases of prolapse despite not securing the neo-vaginal dome to the Denonvilliers fascia [34]. Similar results were reported by Cocci et al. in his series of 94 patients [35]. Authors who do not routinely secure the dome of the neo-vagina to the Denonvilliers fascia, claim that a proper regimen of neo-vaginal dilation allows adequate fixation of the inverted flaps to the fundus of the neo-vagina thanks to the adhesions that form during healing process.

### Urethral neo-meatus stenosis and urinary disorders

Stenosis of the urethral meatus can occur in up to 5% of patients [14]. This complication can be avoided with an adequate urethral spatulation and mucosal eversion. This complication can also be ischemic in nature and therefore an adequate dissection along the surgical planes will help to preserve an adequate blood supply thus minimizing the risk of stenosis.

Urinary complaints are not uncommon after vaginoplasty. In a series published by Hoebeke, 19% of patients suffered from incontinence (stress, urge or mixed) and urinary dribbling [36]. Pelvic floor physical therapy may be useful for patients with bothersome urinary symptoms and stress urinary incontinence may be managed with transurethral injection of bulking agents in the bladder neck [12]. In the current series, although 2 patients experienced an urinary retention after catheter removal, no long-term urinary complications were reported at postoperative follow up.

### Dyspareunia and sexual outcomes

Patients' expectations regarding functional outcomes of surgery often have a great influence on their overall postoperative satisfaction.

Pain during penetrative intercourses has been described by 2–6% of patients [14, 26]. As confirmed by Eldh et al., the retention of spongy tissue and its swelling during sexual activity can cause difficult penetration, dyspareunia and partner's discomfort during intercourse. Based on these findings the Author suggested that the spongiosum should be completely removed [4]. MRI can represent an extraordinary diagnostic tool in the evaluation of patients with dyspareunia, as it can easily identify the presence of remnants of the corpus spongiosum [37, 38].

The results of the current series are in line with the prevalence of dyspareunia reported in the literature, as two (4.4%) patients complained of painful sexual intercourse 12 months after surgery;

in both cases no remnants of the corpus spongiosum were demonstrated at MRI.

With regards to sexual satisfaction, results reported in the literature are heterogeneous [39]. In particular, in a series of 232 patients, Lawrence et al. reported that only 15% of them could reach orgasm during masturbation [19].

In his series of 50 patients, Wagner reported that 30% of patients were not able to reach orgasm after surgery [6].

More recently Cocci et al. published their experience with M shape neo-clitorolabioplasty on 94 patients. In this series, 82.9% of patients reported erogenous sensation during dilatation, penetrative intercourse or masturbation [35].

In the current series, 40 patients (88.9%) were able to reach climax 12 months postoperatively and we believe that embedding the neo-clitoris in a moist urethral mucosa environment contributes in keeping it moist and sensitive, maximizing the chances of achieving orgasm. In addition, this technique guarantees a pleasant aesthetic appearance, very similar to the clitoris of a genetic female.

Our series shows that  $\frac{3}{4}$  of the study population had neo-vaginal intercourse one year after surgery. The improvement of functional outcomes in a quite short period between 3 and 12 months was impressive and in line with previous series showing a significant improvement in patients' satisfaction at one year follow up [13].

### Aesthetic complications

Unsatisfactory aesthetic results are the most common reason for reinterventions in transgender women. Raigosa et al. found that almost 1 in 4 patients requested revision surgery such as lipofilling, scar revision and/or removal of excess skin [25].

Frequently encountered imperfections are scrotal-like appearance of the labia majora and inadequate closure of the upper labial commissure: in both cases a secondary revision can provide good results.

An excessive welding of the lower labial commissure can be easily corrected under local anaesthesia in order to avoid difficulties during intercourse and self-dilatations.

Hypertrophy of the neo-clitoris perceived by patients as larger than expected represents another reason for reintervention; patients need to be warned that remodelling can be performed but at the cost of jeopardising erogenous sensitivity.

The persistence of remnants of the crura of the corpora cavernosa can create an asymmetry especially if they engorge during arousal and intercourse. It is therefore paramount to remove as much of the crura as possible. Sclerotization of the residual cavernosal tissue can also be a valuable option in our experience.

Despite all patients now undergo permanent laser epilation of perineal area and genitalia in order to avoid future hair growth inside the neo-vagina, ~29% of patients are concerned about neo-vaginal hair growth [3]: this inconvenience can be managed with diathermocoagulation, mechanical removal or hair removal creams.

In the present series only one patient reported being dissatisfied with aesthetic appearance 12 months postoperatively: according to our findings it could be reasonable to wait until the first year after surgery before proposing a surgical correction.

### Limitations

The main limitations of this series are the small number of patients enrolled, the retrospective nature and the relatively short follow up. These drawbacks could limit the value of our findings.

### CONCLUSIONS

Short and long-term complications are not uncommon after vaginoplasty, even when surgery is carried out in dedicated

centres by high volume skilled surgeons. Our modified vaginoplasty technique with the urethral flap spatulated in a "Y" fashion is a valuable option in transgender women as it is associated with excellent cosmetic and functional results. The review of the literature has highlighted the need to standardize a postoperative follow up protocol with particular regard to postoperative dilatation regimens. Further and larger randomized clinical trials will be required in order to draw definitive conclusions.

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## AUTHOR CONTRIBUTIONS

LO: project design, data acquisition and interpretation, manuscript drafting, final approval. GG: data acquisition and interpretation, manuscript revising, final approval. FM: data acquisition, manuscript revising, final approval. MR: data acquisition and interpretation, manuscript revising, final approval. FT: data acquisition, manuscript revising, final approval. MF: manuscript revising, final approval. SB: manuscript revising, final approval. TC: manuscript revising, final approval. AP: manuscript revising, final approval. CT: manuscript revising, supervision, final approval. GL: project design, data acquisition and interpretation, manuscript revising, supervision, final approval.

## COMPETING INTERESTS

The authors declare no competing interests.

## ADDITIONAL INFORMATION

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